BREEDING ECOLOGY OF AMERICAN AND CARIBBEAN COOTS AT SOUTHGATE POND, ST. CROIX: USE OF WOODY VEGETATION

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ABSTRACT.—American (*Fulica americana*) and Caribbean (*F. caribaea*) coots nested colonially at brackish Southgate Pond, St. Croix, United States Virgin Islands (USVI), following a 50-year rainfall event in mid-November 2003. Breeding occurred during three time periods: seven pairs bred from 6 December to 2 January (early), seven from 17 January to 15 February (middle), and eight from 26 April to 19 May (late) (range of clutch initiation dates = 165 days). Hatching success was high (65.3%), but overall reproductive success was low (27%) owing to poor brood survival. Coots built all but 2 of 22 nests at the water line in sturdy crotches of small, live white mangroves (*Laguncularia racemosa*); two late nests were built on remnant stubs of dead white mangroves after water levels had sharply declined. Early pairs nested in manglars (islets of one or more mangroves without solid land) farther away from shore and in deeper water than middle or late pairs (65.6 versus 42.1 and 29.0 cm, respectively). Southgate Pond remains the preferred breeding site for coots on St. Croix and the USVI. Coots have also recently nested on St. Croix at seven semi-permanent or permanent, man-made, freshwater ponds where they have probably been overlooked, as coots respond rapidly to changes in water levels at semi-permanent or permanent wetlands. Predominance of non-assortative pairing at Southgate Pond suggests that American and Caribbean coots are morphs of one species. *Received 7 February 2005, accepted 7 November 2005.*

The Caribbean Coot (*Fulica caribaea*) is not globally threatened (Taylor 1996), but the species is listed as locally endangered in the United States Virgin Islands (USVI; Indigenous and Endangered Species Act of 1990) and is considered threatened throughout the West Indies, especially breeding populations (Raffaele et al. 1973, 1998). Caribbean and American (*F. americana*) coots are two of the rarest bird species that nest in wetlands of the USVI, including St. Croix (Beatty 1930, Raffaele 1989), and their breeding ecology in the Caribbean is poorly known (Taylor 1996, Brisbin et al. 2002). In North America, American Coots are associated with freshwater marshes and low-salinity brackish wetlands (Kantrud 1985).

Following the largest rainfall event in over 50 years, we studied the breeding ecology of Caribbean and American coots at Southgate Pond, the largest seasonal brackish pond on St. Croix. Although degraded by previous

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coastal development, Southgate Pond is still one of the most productive mangrove wetlands for birds on St. Croix (Scott and Carbonell 1986, Sladen 1992; DBM and CCB unpubl. data). We describe coot breeding adaptations in use of woody vegetation as nest sites (Sugden 1979), and provide information on phenology, clutch size, and breeding success. We also present recent breeding information (since 2002) on coots for seven other sites on St. Croix, formulate management strategies (especially for Southgate Pond), and assess the taxonomic significance of pairing between the two species.

METHODS

During 2003–2004, we studied American and Caribbean coots at Southgate Pond, a 17.9-ha wetland (17° 45′ 29.6″ N, 64° 39′ 45.9″ W) on St. Croix, USVI. We used the criteria of Roberson and Baptista (1988) to distinguish American (types A and B) from Caribbean coots (types C, D, and E) in the field. A small percentage (≤1.4%) of the males with broad, high, and bulbous shields may be white-shielded morphs of American Coots (Roberson and Baptista 1988). Types A and B have a dark chestnut or red-brown corneous callus, whereas types C, D, and E lack a callus. After becoming familiar with vocal dif-

ferences between the sexes (Gullion 1950), we also identified the genders of some coots at their nests. Males were larger than females and had larger shields and bills, regardless of species, which agrees with expectations based on size and hormonal differences between the sexes (Gullion 1951; Fredrickson 1968, 1970).

We visited Southgate Pond twice a week after the first nest was discovered in early January 2004. Nests were marked with numbered flagging and the location of each nest was recorded with a Global Positioning System (GPS) unit and plotted on a map using ArcView 3.2. We recorded the coot species associated with each nest and coot behavior during each nest visit. Some individuals were not identified to species because of their elusive behavior. Dates of clutch initiation for nests found during laying were calculated by backdating and assuming that one egg was laid per day (Gorenzel et al. 1982, Brisbin et al. 2002). Assuming a 23-day incubation period (Brisbin et al. 2002), initiation dates for nests found after laying were estimated based on hatch dates minus 1 day (the day on which the first egg hatched). For failed nests, we adjusted hatch date for incomplete or under-recorded clutch sizes based on the mean clutch size and backdating from the midpoint between the first and last egg dates. Because our potential renest intervals were long, renests were not assigned to any one pair of coots (based on criteria in Arnold 1993).

We used the method of Mayfield (1975), as modified by Johnson (1979), to calculate hatching success (based on a 23-day incubation period). To determine reproductive success, we followed the fate of individuals and broods until they were fully grown and independent (60–70 days; Taylor 1996). Young coots leave the nest on the day of hatching and broods are difficult to count accurately when young birds hide in emergent vegetation (Gullion 1956); however, emergent vegetation was scarce at Southgate Pond. As young acquired juvenal plumage (~3 weeks old) they left the breeding area for deeper water along the northwestern shore of Southgate Pond, where different broods coalesced into larger flocks and were easier to see and count. All nesting attempts had known outcomes and we calculated reproductive success (number of young fledged/number of eggs laid) by (1)

multiplying the number of active nests by mean clutch size to derive an estimate of the total number of eggs laid, and (2) dividing the number of fully grown and independent young (not broods *per se*) by eggs laid. Fledging success (number of young fledged/number of eggs hatched) was determined by dividing reproductive success by hatching success. The number of breeding pairs was based on the number of active nests. Coot nest density at Southgate Pond and the seven man-made freshwater ponds was calculated based on pond area and the number of nests or pairs simultaneously active at each pond. Assessment of intraspecific brood parasitism ("nest-dumping") followed the criteria of Post and Seals (2000).

We recorded the following parameters at each active nest and nest site: nest height from the water line to the top of the nest rim (cm), length and width of outer nest cup (cm), length and width of inner lining (cm), water depth below the nest (cm), above-water height (cm) and greatest breadth (m) of the white mangrove, distance to nearest white mangrove (m), distance to nearest shoreline (m), distance to nearest active nest (m), and distance to nearest active or inactive nest (m). For each pair of coots, four variables (water depth below the nest, distance from the water line to the top of the nest rim, height of white mangrove above water, distance to nearest shoreline) were adjusted to the date of clutch initiation. We also noted whether white mangroves that contained nests were isolated manglars (islets of one or more mangroves without solid land) or formed a line of connected manglars away from the shoreline. We used a bathymetric map of Southgate Pond to adjust distances between nests and the shoreline by taking the mean value of four distance measurements from the -15.25 to 30.5 cm contour (-0.5 to 1 foot) centered on the main breeding area. We then used sine/cosine functions to calculate an angle of 0.026 degrees, which translated to a 1.9-m change in shoreline distance per cm drop (or rise) in water levels. Baseline water level data (in cm) were recorded *in situ* from several 2-m sticks placed in the lowest bed of the flat-bottomed pond. The water level decline was nearly constant throughout the study period (mean of 0.58 cm/day), except for one heavy rainfall

event when water levels rose 17 cm from 16 to 18 April. We obtained monthly measurements of salinity at Southgate Pond using a temperature-compensated refractometer (accurate to within ± 1 ppt). From December 2003 through July 2004, salinity increased from 4 to 32 ppt as water levels dropped.

To systematically sample coot breeding habitat, we established a grid of 56 line transects, spaced 8 m apart along north-south cardinal directions from 15 m west of the southwestern shoreline and extending to the eastern point of Southgate Pond just beyond the main coot colony. We randomly selected sample points ($n = 436$) every 8 m along each transect. The last point along each transect was a point in open water beyond the vegetation farthest from shore. Water depth (cm), vegetation present or absent (open water), and species composition (if vegetation present) were sampled at each point. We used a random number generator to assign numbers 1 to 22 (i.e., corresponding to the number of coot nests we found) to sample points of water depth. Water depth at each sampled point that contained vegetation was then adjusted to reflect water depth at the observed or estimated date of clutch initiation for each coot nest represented by each random number (e.g., random number one represents coot nest one, which initiated incubation on 6 December). This procedure removed the effects of declining water levels so that vegetation data would be comparable to nest data.

To assess differences in water depths between vegetation and open water and among species of plants, we used two-tailed t-tests and one-way ANOVA (Zar 1999, StatSoft 2002). Because the sample sizes for five of the eight vegetative species/types recorded were small (total $n = 15$), we did not include them in the ANOVA. We used simple linear regression to assess the relationship between water depth below nests and the date of clutch initiation. We used a Mann-Whitney U-test to assess whether water depths at coot nests differed from random and to examine whether phenological or habitat variables were related to hatching outcome (success/fail). We used nonparametric tests (Mann-Whitney U, Kruskal-Wallis H, and Spearman's rank correlation r_s) when sample sizes were small and data did not otherwise meet assumptions of the normal

distribution, including homogeneity of variances and distribution of residuals. For all tests, we used an α value of 0.05. Means are reported ± SD.

RESULTS

We located 22 active coot nests at Southgate Pond during winter and spring of 2003–2004. Dates of clutch initiation ranged from 6 December to 19 May (165 days), with breeding occurring during three periods: early (6 December to 2 January; 27 days), middle (17 January to 15 February; 29 days), and late (26 April to 19 May; 23 days). One nesting attempt during the late period was overlooked (see below). We identified one pair of Caribbean Coots and five Caribbean × American coot pairs (hereafter mixed pairs) during the early period, two pairs of Caribbean Coots and four mixed pairs during the middle period (two male American and two female Caribbean coots were sexed in two of these four mixed pairs), and three pairs of Caribbean Coots and two mixed pairs during the late period (both males were American and both females were Caribbean coots). One of the American Coots of one mixed pair during each of the first two periods was type B (intermediate, *sensu* Roberson and Baptista 1988). The other American Coots appeared to be type A birds. Of the three coots whose mates were not identified, two were Caribbean and one was American.

Clutch size decreased as the nesting season progressed ($r_s = -0.56$, $P = 0.025$) and averaged 6.88 ± 1.41 eggs (range = 5–9, $n = 16$). Seventeen of 22 nests (77%) hatched at least one chick, and only 5 of the 130 eggs (3.8%) that remained unbroken in the nest bowl throughout the normal incubation period failed to hatch. Daily nest survival (s) was 0.982 ± 0.008 SE and hatching success was 65.3% (Mayfield method). Hatching success was not related to clutch initiation dates ($U = 26$, $Z = 1.29$, $P = 0.20$) or any other phenological or habitat variable, although successful nests generally began earlier and had larger clutches, greater water depths, and were farther away from shore than failed nests. Forty-one young became fully grown and independent 60–70 days after hatching. This excludes three young—attended by a pair of Caribbean Coots—that fledged from a ninth nest over-

TABLE 1.   Measurements of 14 nest and nest-site parameters for 22 coot nests built in white mangroves at Southgate Pond, St. Croix, U.S. Virgin Islands, during winter and spring of 2003–2004.

Parameter	Mean ± SD	Range
Nest height from water line to top of nest rim (cm)	13.5 ± 6.9	4.8–35.5
Length of outer nest cup (cm)	35.9 ± 8.8	25.4–61.0
Width of outer nest cup (cm)	28.6 ± 4.2	20.3–36.2
Length of inner lining (cm)	19.8 ± 2.2	15.5–25.4
Width of inner lining (cm)	18.0 ± 2.1	14.0–22.9
Water depth below nest (cm)	44.8 ± 17.6	15.0–78.5
Above-water height of white mangrove (m)[a]	1.9 ± 0.6	1.0–3.7
Greatest breadth of white mangrove (m)[b]	3.9 ± 1.1	1.5–5.8
Distance to nearest white mangrove (m)[c]	3.2 ± 2.4	0.0–8.5
Distance to nearest shoreline (m)	48.4 ± 26.0	10.4–98.1
Distance to nearest active nest (m)	60.4 ± 59.6	18.7–308.2
Distance to nearest active nest (m)[d] (excluding three isolated nests)	42.7 ± 13.5	18.7–60.2
Distance to nearest active or inactive nest (m)	42.3 ± 59.9	10.2–283.9
Distance to nearest active or inactive nest (m)[d] (excluding three isolated nests)	23.1 ± 11.3	10.2–50.5

[a] One outlier excluded (dead white mangrove: nest 17; height <20 cm).
[b] Two outliers excluded (one dead white mangrove and one live white mangrove: nests 17, 21; breadth not measured and = 55.7 m, respectively).
[c] One outlier excluded (live white mangrove: nest 22; distance = 127.9 m).
[d] One isolated nest excluded from each of early, middle, and late nesting periods (nests 7, 13, and 17).

looked during the late period (date of clutch initiation was later than 19 May). The largest single brood observed comprised five young (from a mixed pair), and there were six broods (from four mixed pairs and two Caribbean Coot pairs) with four young. Reproductive success was 27%, and fledging success was 41.3%.

Nests were built along the water line in partially submerged, small, live white mangroves (*Laguncularia racemosa*; Table 1). Most nests were placed either in the central crotch (early and middle periods) or in smaller crotches of outside branches (late period); two nests during the late period were also placed either on remnants of dead white mangroves under live vegetation or on unconcealed dead white mangroves. All nests during the early and middle periods had short or long ramps, while only two nests during the late period had ramps. Nests were in isolated manglars ($n = 18$) or in rows of manglars ($n = 4$), but away from mangroves that formed the outer fringes of Southgate Pond's vegetated shoreline. Nests were located close to nest materials, the bulk of which (excluding sticks and twigs of mangroves) consisted of shoreline sea purslane (*Sesuvium portulacastrum*), a perennial succulent forb also used to construct most of the ramps. Seed pods of *Sesbania sericea*, a short-lived shrub, composed the inner nest lining of several nests. The dominant submerged plant (forb) of Southgate Pond was widgeon grass (*Ruppia maritima*), but this species was not used as nest material. Most manglars, both white and black (*Avicennia germinans*) mangroves, were located at the east end of the pond, where most nests were concentrated (Fig. 1). Two rather isolated nests (7, 13) were near the southwestern shoreline, and the most isolated nest (17) was near the northwestern shoreline. The density of coot nests during the three periods was 0.39–0.45 nests/ha.

Mean water depth at nests was 44.8 cm (Table 1) and declined throughout the breeding season (early period: 65.6 cm ± 11.0; middle period: 42.1 cm ± 3.8; late period: 29.0 cm ± 9.5; Kruskal-Wallis $H = 15.14$, $P < 0.001$; Fig. 2). Early nests were also farther away from the shoreline than middle or late nests (early period: 70.0 m ± 29.7; middle period: 49.6 m ± 11.2; late period: 28.5 m ± 15.8; Kruskal-Wallis $H = 8.81$, $P = 0.010$). Other comparisons of nest or nest-site variables between early, middle, and late periods were not significantly different.

Vegetation sampled at random points along line transects composed 34.6% ($n = 151$) of breeding habitat; the remainder was open water ($n = 285$), where mean water depth was significantly greater than in vegetated areas (open water: 45.8 cm ± 27.3; vegetation: 37.4 cm ± 26.2; $t = 3.11$, df = 434, $P = 0.002$). Live white and black mangroves and dead

FIG. 1.   The location of 22 coot nests at Southgate Pond, St. Croix, U.S. Virgin Islands, during winter and spring of 2003–2004.

white mangroves dominated vegetation types within breeding habitat, and mean water depths at dead and live white mangroves were significantly deeper than at black mangroves ($F_{2,134} = 8.28$, $P < 0.001$; Table 2). Mean water depths at live white mangroves with and
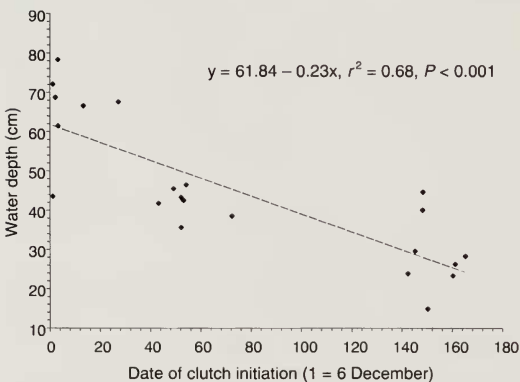

FIG. 2.   Relationship between water depth below 22 coot nests and the date of clutch initiation at Southgate Pond, St. Croix, U.S. Virgin Islands, during winter and spring of 2003–2004.

without coot nests were similar (without nests: 39.3 cm ± 25.7; with nests: 44.8 cm ± 17.6; Mann-Whitney $U = 434.5$, $P = 0.24$).

Freshwater ponds.—Since 2002, 1–3 pairs of Caribbean Coots and mixed pairs have bred intermittently year-round at seven man-made, freshwater ponds on St. Croix, which range in size from 0.1 to 2.9 ha. The mean coot density at all sites combined for all breeding sequences over the 4 years was 4.2 pairs/ha (range = 0.3–10.0, $n = 17$) and apparent hatching success was high (16 of 24 nests based on hatch rates of the proportion of nests found). Most breeding records occurred after the 50-year rainfall event of mid-November 2003 filled the ponds. This event followed a dry period, when a variety of plant species had colonized the bottom of many dry, or nearly dry, ponds. In addition, the Virgin Islands Agricultural Station Middle Pond (see McNair 2006 for list of pond names and their locations on St. Croix) was deliberately drained during winter 2002–2003. Water levels varied between years at several sites when nesting occurred, espe-

TABLE 2.   Mean water depth (cm) for eight vegetation types at Southgate Pond, St. Croix, U.S. Virgin Islands, during winter and spring of 2003–2004.

Vegetation type	*n*	Mean ± SD[b]
Dead *Laguncularia racemosa*	54	45.4 ± 26.9 A
Live *Laguncularia racemosa*	48	39.3 ± 25.7 A
Live *Avicennia germinans*	34	23.2 ± 21.2 B
Dead *Avicennia germinans*	3	38.6 ± 20.6[c]
Sesbania sericea	4	43.9 ± 17.0[c]
Sesuvium portulacastrum	4	27.8 ± 28.8[c]
Sesuvium portulacastrum on dead *L. racemosa*	2	52.7 ± 20.2[c]
Sporobolus virginicus[a]	2	6.8 ± 29.1[c]
All vegetation	151	37.4 ± 26.2
Open water	285	45.8 ± 27.3

[a] Seashore rush grass.
[b] Overall $F_{2,134}$ = 8.28, $P < 0.001$; rows with different letters (A, B) are significantly different (Tukey's unequal *n* HSD *post-hoc* tests: $P = 0.026$ for live *Avicennia germinans* versus live *Laguncularia racemosa*; $P < 0.001$ for live *A. germinans* versus dead *L. racemosa*).
[c] Sample size too small to test.

cially at the Virgin Islands Agricultural Station Middle Pond. Live creeping burrhead (*Echinodorus berteroi*) was almost absent there in 2004, when the pond was not used by coots and emergent vegetation was restricted to the shoreline when the water level was higher. Although coots nested in a variety of live (five species) and dead (two species) vegetation, woody (especially remnant *S. sericea*, at four ponds) vegetation rather than perennial herbaceous vegetation was the predominant nest substrate (18 of 27, 67%). Nests ranged from 4 to 33.5 m away from the shoreline, and water depths below nests were generally greater for nests built in woody vegetation, especially *S. sericea* (usually 1.25–2.25 m). The bulky, conspicuous nests composed of sticks of *S. sericea* (~90 × 65 cm) were superficially shaped like the above-water portion of a beaver lodge. Anthropogenic disturbance at these seven ponds was negligible except around Carlton North Pond, where all vegetation except that fringing the shoreline was cleared for a housing development in early October 2004; however, coots continue to breed at Carlton North Pond.

DISCUSSION

Because of a drought on St. Croix that began in 2002, the bottom of Southgate Pond was dry in 2003 until water from heavy rains began to fill the pond in late August. Nonetheless, the basin was only about one-quarter full until a 50-year rainfall event during 10–14 November 2003 caused Southgate Pond to overflow. Coots colonized the pond and began laying eggs within 2–3 weeks after this seasonal wetland filled with water, typical of coots after arrival on their breeding grounds (Alisauskas and Arnold 1994).

When conditions are suitable, Southgate Pond is probably the preferred breeding site for coots on St. Croix (and in the USVI; McNair 2006), even though freshwater ponds, each with a small number of birds, support higher breeding densities (this study). Although Southgate Pond is brackish, the number of breeding pairs during three consecutive periods from December to May did not decline as salinity increased from low to moderately brackish; elsewhere, breeding densities typically decline as salinity increases (Kantrud 1985, Arnold 1993). Regardless, semi-permanent or seasonal wetlands are generally preferred habitat for American Coots in North America (Kantrud 1985, Arnold 1993, Alisauskas and Arnold 1994). Nests at Southgate Pond, which generally lacked emergent herbaceous vegetation, were built in woody vegetation. In Saskatchewan, small, isolated, partially submerged willow (*Salix* spp.) clumps were used as nest sites for a substantial percentage (22%) of American Coot nests during a wet year (Sugden 1979), although willows were not used as nest materials. This is different from what we observed at Southgate Pond, where white mangroves served as nest sites and as nest-building material; remnant or live woody plants (especially remnant *S. sericea*) at freshwater ponds on St. Croix were

used similarly. In another Saskatchewan study, coot nests were composed of the same plant species that provided support for the nest (cf. Sutherland and Maher 1987).

Water depths below many nests in fresh-water ponds on St. Croix were much deeper than water depths below nests in white mangroves at Southgate Pond. Apart from Southgate Pond, the most suitable freshwater breeding site for coots on St. Croix has been Granard South Pond, where three pairs nested in remnant *Sesbania* and other nest sites. Unlike mangroves at Southgate Pond, suitable remnant woody vegetation at freshwater ponds usually becomes available only when these ponds dry up and then refill with water, which kills the colonizing shrubs. Emergent vegetation suitable for nests at some of these ponds can be scarce, even when water levels are low. Nests in perennial emergent forbs were floating platforms built amongst this vegetation, which is typical of coot nests in marshes (Fredrickson 1970, Sugden 1979, Gorenzel et al. 1982, Kantrud 1985, Post 1990, Alisauskas and Arnold 1994, Frost and Massiah 2001).

At Southgate Pond, water depths at coot nests during each period were typical of those observed at American Coot nests on the North American mainland (Sugden 1979, Gorenzel et al. 1982, Sutherland and Maher 1987, Post 1990, Arnold 1993), although depths during the third period were rather shallow. Even though coots on the North American mainland frequently nest in residual emergent vegetation (Gorenzel et al. 1982, Alisauskas and Arnold 1993), in our study they probably avoided using dead white mangroves as nest sites in deeper water at Southgate Pond because nests in these sites would have been exposed. Were it not for the effects of hurricanes Hugo and Marilyn in 1989 and 1996, which killed many white mangroves farther from shore, several more pairs of coots may have used these mangroves as nest sites. Coots also avoided nesting in black mangroves, which are generally located closer to shore than the live white mangroves they used. Water depths at nests in white mangroves during the late period were similar to mean depths at black mangroves, suggesting that water depth at black mangroves was otherwise acceptable to coots. However, coots generally prefer deeper water farther from shore (Sutherland and

Maher 1987, Post 1990, Arnold 1993). Furthermore, white mangroves offer superior structural support for nests (black mangroves lack the sturdy bowl-shaped central crotch and low lateral branches) and greater concealment. For similar reasons, American Coots in Saskatchewan nested in live willows but not quaking aspens (*Populus tremuloides*) (Sugden 1979).

As water levels declined, nest-site selection changed; by the late period, the central crotches of white mangroves were no longer suitable (too far above water). Nonetheless, inter-nest distances remained similar during all three periods, suggesting that territory sizes (which were not measured) also remained similar. Inter-nest distances between simultaneously active (or inactive) nests during all three periods were typical of those observed for coots elsewhere, although published data are unavailable for nests limited to woody vegetation. Unlike what has been observed at many North American sites characterized by emergent vegetation, coots at our study site built few non-nesting platforms (six in white mangroves), and the distribution and structure of nesting cover at Southgate Pond did not change over the breeding season. Given the fixed number of live white mangroves as potential nest sites for coots at Southgate Pond, territorial behavior probably prevented any additional coot pairs from breeding at the site. The location of coot nests is mainly controlled by territorial spacing, distance from shore, and the distribution and structure of nesting cover (Gullion 1953, Sugden 1979, Sutherland and Maher 1987). Water depth, although correlated with distance from shore in this study, was probably a less important factor in nest-site selection.

Nest concealment in woody vegetation must have been effective because hatching success at Southgate Pond was high. Apparent hatching success was also high at freshwater sites, which is typical of American Coots (Gorenzel et al. 1982, Alisauskas and Arnold 1994, Brisbin et al. 2002). Intraspecific nest parasitism was not observed at Southgate Pond or at the freshwater ponds. Fledging success at Southgate Pond, although not consistently associated with differences in water depth, was low (<41%). This contrasts with apparent fledging success at freshwater sites

(this study), and that in North America, which is generally high (>50%; Alisauskas and Arnold 1994). Most broods observed at Southgate Pond consisted of 2–3 birds, lower than the number typically observed at freshwater ponds (7 of 13 broods had ≥4 fledged young). Thus, we speculate that brood losses within 5 days after hatching exceeded 50% at Southgate Pond. Low survivorship of young also occurred during the early brood period for White-cheeked Pintails (*Anas bahamensis*) at Humacao, Puerto Rico (F. J. Vilella pers. comm.), where most losses were attributed to rats (*Rattus* spp.), Great Egrets (*Ardea alba*), and Black-crowned (*Nycticorax nycticorax*) and Yellow-crowned (*Nyctanassa violacea*) night-herons. All of these potential predators were present at Southgate Pond.

Despite low reproductive success at Southgate Pond, the long intervals between breeding periods and the similar number of pairs breeding during each period suggest that some middle and late period nests were probably second or third broods rather than renests. Presumed success of second nesting attempts also occurred at three of the seven freshwater ponds. Nesting during the late period at Southgate Pond appeared to be possible because of heavy rainfall that occurred from 16 to 17 April, when water levels rose 17 cm, allowing coots to reset their breeding clock despite an overall drop in water level (14 cm) since the middle breeding period. Before the 50-year rainfall event of mid-November 2003, coots probably last nested at Southgate Pond in 2001, following the previous torrential rainfall event of 8 May when water filled the pond (CCB unpubl. data). This opportunistic, multi-brooded breeding response to aquatic periods resulting from torrential vernal and autumnal rainfalls in an otherwise semi-arid environment may allow coots to overcome generally low reproductive success on St. Croix. Nevertheless, three breeding periods during one aquatic phase is probably exceptional (DBM and CCB unpubl. data). How frequently and successfully coots breed at Southgate Pond and freshwater sites on St. Croix in the future is currently being determined through an ongoing wetlands bird-monitoring scheme.

Management recommendations.—Southgate Pond (now part of the Southgate Coastal Reserve owned by the St. Croix Environmental Association) remains favorable habitat for nesting coots, even though environmental degradation has diminished this brackish pond to <50% of its original size (Gaines 2004, Gaines and Gladfelter 2004). The most difficult task at Southgate Pond is to maintain appropriate water levels for coot nest initiation during seasons and years when rainfall is insufficient. We endorse Gaines and Gladfelter's (2004:54–56) two major recommendations for water management to prolong the aquatic phase of Southgate Pond: (1) divert water into the pond, and (2) raise the maximum water depth from ~103 to ~138 cm. Manipulation of water levels should favor nesting coots and other wetland birds, although it may eliminate species that nest in terrestrial sites. During its dry phase, two species of conservation concern on St. Croix may nest at Southgate Pond: Wilson's Plover (*Charadrius wilsonia*) and Least Tern (*Sterna antillarum*). However, both species breed at more than 10 sites and are not as rare as coots. Furthermore, Southgate Pond is the best-documented site for coots in the eastern Caribbean (McNair 2006). When water levels are sufficient, the brackish habitat at Southgate Pond may be similar to that of brackish impoundments along the northern Gulf coast of the United States (e.g., an abundance of sea purslane and widgeon grass), where coots are abundant (Swiderek et al. 1988).

At the seven man-made, freshwater ponds, piped water is generally the best management option to maintain stable, generally high water levels. The most suitable freshwater site in the eastern Caribbean (Barbados) is man-made Marshall's Pond, which is dominated by *Echinodorus berteroi* (Frost and Massiah 2001; M. D. Frost pers. comm.), the herbaceous species used most frequently for nest sites on St. Croix. Maintaining stable water levels at the best site on St. Croix (Granard South Pond), as well as at the other ponds, should generally favor *E. berteroi* and other species with similar vegetative characteristics. Woody vegetation would no longer compose the dominant nest sites because stable water levels would generally prevent woody plants such as *S. sericea* from becoming established except along the immediate shorelines of these ponds.

Caribbean Coot systematics.—The taxonomic status of the Caribbean Coot requires

further investigation (Roberson and Baptista 1988; also Gullion 1951, Phillips 1967, Payne and Master 1983, Clark 1985, Taylor 1996). Apparent non-assortative pairing of coots prevailed at Southgate Pond, where both types of coots occurred. One-half of the pairs at freshwater sites on St. Croix were paired non-assortatively. Furthermore, at least some mixed pairs successfully raised young, especially at Southgate Pond, indicating that the two types of coots can produce viable offspring (Gill 1964, Payne and Master 1983, Bond 1984). Thus, American and Caribbean coots may compose one species with variant, intergraded phenotypes of which A and E birds represent the extreme types. Although some birds can be individually recognized in the field, an accurate assessment of phylogenetic relationships and the taxonomic status of American and Caribbean coots will require studies based on morphological and genetic analyses along with observations of mating behavior and pair bonds of marked birds. This will also require confirming identification of shield characteristics and correlating them with other morphological measurements.

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